INFUSION PUMP ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application is a continuation of U.S. application Ser. No. 13/946,506 filed on Jul. 19, 2013, which is a continuation of U.S. application Ser. No. 12/347,985 filed on Dec. 31, 2008, which claims the benefit of provisional application 61/018,054, filed Dec. 31, 2007, provisional application 61/018,042, filed Dec. 31, 2007, provisional application 61/017,989, filed Dec. 31, 2007, provisional application 61/018,002, filed Dec. 31, 2007, provisional application 61/018,339, filed Dec. 31, 2007, provisional application 61/023,645, filed Jan. 25, 2008, provisional application 61/101,053, filed Sep. 29, 2008, provisional application 61/101,077, filed Sep. 29, 2008, and provisional application 61/101,105, filed Sep. 29, 2008, each of which is herein incorporated by reference in their entirety.

FIELD OF THE INVENTION

[0002] This application relates generally to fluid delivery systems, and more particularly to infusion pump assemblies.

BACKGROUND

[0003] Many potentially valuable medicines or compounds, including biologicals, are not orally active due to poor absorption, hepatic metabolism or other pharmacokinetic factors. Additionally, some therapeutic compounds, although they can be orally absorbed, are sometimes required to be administered so often it is difficult for a patient to maintain the desired schedule. In these cases, parenteral delivery is often employed or could be employed.

[0004] Effective parenteral routes of drug delivery, as well as other fluids and compounds, such as subcutaneous injection, intramuscular injection, and intravenous (IV) administration include puncture of the skin with a needle or stylet. Insulin is an example of a therapeutic fluid that is self-injected by millions of diabetic patients. Users of parenterally delivered drugs may benefit from a wearable device that would automatically deliver needed drugs/compounds over a period of time.

[0005] To this end, there have been efforts to design portable and wearable devices for the controlled release of therapeutics. Such devices are known to have a reservoir such as a cartridge, syringe, or bag, and to be electronically controlled. These devices suffer from a number of drawbacks including the malfunction rate. Reducing the size, weight and cost of these devices is also an ongoing challenge. Additionally, these devices often apply to the skin and pose the challenge of frequent re-location for application.

SUMMARY OF THE INVENTION

[0006] According to a first implementation, a wearable infusion pump assembly includes a reservoir for receiving an infusible fluid, and a fluid delivery system configured to deliver the infusible fluid from the reservoir to an external infusion set. The fluid delivery system includes a volume sensor assembly configured to receive a quantity of the infusible fluid from the reservoir. The volume sensor assembly includes an acoustically contiguous region having a volume that varies based upon the quantity of infusible fluid received from the reservoir. The volume sensor assembly further includes an acoustic energy emitter configured to provide acoustic energy at a plurality of frequencies to excite a gas included within the acoustically contiguous region.

[0007] One or more of the following features may be includes. The volume sensor assembly may further include a first acoustic energy receptor for receiving at least a portion of the acoustic energy provided by the acoustic energy emitter, and for defining an acoustic response for each of the plurality of frequencies. A second acoustic energy receptor may receive at least a portion of the acoustic energy provided by the acoustic energy emitter and for defining an acoustic reference for each of the plurality of frequencies.

[0008] The acoustically contiguous region may include a variable volume chamber, that may have a volume that varies based upon the quantity of infusible fluid received from the reservoir. The acoustically contiguous region may also include at least one fixed volume chamber, which may have a volume that is constant regardless of the quantity of infusible fluid received from the reservoir. At least one acoustic port may acoustically couple the variable volume chamber to the at least one fixed volume chamber.

[0009] The first acoustic energy receptor may be an invariable microphone positioned proximate the variable volume chamber. The second acoustic energy receptor may be a reference microphone positioned proximate the at least one fixed volume chamber.

[0010] The wearable infusion pump assembly may further include at least one processor, and a computer readable medium coupled to the at least one processor. The computer readable medium may include a plurality of instructions stored on it. When executed by the at least one processor, the instructions may cause the at least one processor to perform operations including determining a phase relationship between the acoustic response and the reference for each of the plurality of frequencies. The computer readable medium may further include instructions for calculating a change of volume characteristic based, at least in part, upon the phase relationship between the acoustic response and the acoustic reference for each of the plurality of frequencies.

[0011] The wearable infusion pump assembly may further include a disposable housing assembly, which may include the reservoir and a first portion of the fluid delivery system. The wearable infusion pump assembly may also include a reusable housing assembly, which may include a second portion of the fluid delivery system. A first portion of a pump assembly may be positioned within the disposable housing assembly. A second portion of the pump assembly may be positioned within the reusable housing assembly. The pump assembly may be configured to extract the quantity of the infusible fluid from the reservoir and provide the quantity of the infusible fluid to the volume sensor assembly.

[0012] A first portion of a first valve assembly may be positioned within the disposable housing assembly. A second portion of the first valve assembly may be positioned within the reusable housing assembly. The first valve assembly may be configured to selectively isolate the pump assembly from the reservoir. A first portion of a second valve assembly may be positioned within the disposable housing assembly. A second portion of the second valve assembly may be positioned within the reusable housing assembly. The second valve assembly may be configured to selectively isolate the volume sensor assembly from the external infusion set.